

FARM FRESH

Produced by Saskatchewan Agriculture and Food

Garlic (*Allium sativum*), a member of the Amaryllidaceae (Amaryllis Family), is an herbaceous perennial that is often grown as an annual crop. Garlic has been grown for more than 5000 years and is thought to have originated in central Asia around the Caspian Sea and eastward toward China. Eventually garlic was distributed to China, the Middle East, and Europe, and ultimately to other continents. Garlic was probably first grown in Saskatchewan by Russian and East European immigrants who brought their own garlic strains with them.

The Plant

Garlic is a bulbous plant that goes dormant in winter. The bulbs are composed of smaller divisions called cloves, which may vary in number from 3 to 40, depending on cultivar, growing conditions and maturity of the bulb. The long, narrow, flat leaves are borne alternately on the stem and are green or bluish-green. Some strains of garlic will flower (called hardneck, topset or rocambole) while others (softneck, artichoke or silverskin) rarely do. Those that flower will

produce small bulbils rather than seeds. Hardneck garlic is generally considered more flavorful and is easier to peel, with fewer, but larger cloves, although it is harder to store for long periods. Recent research in Saskatchewan has indicated that garlic grown in northern climates represents better planting material than garlic grown at more southerly locations.

Garlic will break dormancy after about 4 months in storage. It is a hardy plant, adapted to cool seasons. Many cultivars will survive very low temperatures in winter, and even young tops are quite frost tolerant. Roots will grow at temperatures above 8°C. Temperatures above 30°C, however, will inhibit bulb formation and cause foliage to senesce prematurely. For this reason garlic needs to be planted early so that vigorous top growth will occur in May and June.

Culinary Uses

Garlic has been widely used in cooking for centuries, but it is much more highly esteemed in some ethnic groups than others. It can have a strong flavor and

pungent odor, and the odor is often imparted to the consumer. This is more of a problem when garlic is used raw, for cooking makes it milder. Garlic is used to flavor soups, stews, salads, salad dressings, and spreads. Usually it is the cloves that are used, but occasionally the leaves are used. In oriental cooking, flowering scapes are also commonly used. Commercially, garlic is also pickled, dehydrated or used to flavor salt or oil. Garlic has been found to be high in fiber, minerals, vitamins and amino acids

Medicinal Uses

Although garlic has been recommended for medicinal purposes since ancient times in various cultures, it is only recently that some of its uses are being documented as medicinally valid. It is well known that garlic contains allicin, a natural antibiotic compound. Garlic is now promoted as having value in treating high cholesterol, upper respiratory tract infections, improving circulation and occasionally as preventing cancer. It has been used in cardiovascular care, diabetes treatment, digestive

disorders, allergies and asthma, and to increase immunity.

Garlic products are now widely sold as herbal supplements. This may be in the form of garlic oil capsules, tablets and capsules of unstandardized and standardized potency and as liquid extracts.

Odorless liquid extracts and powders or tablets are also sold, but the effectiveness of some of these products has been questioned. Medicinal value of commercial garlic preparations is highly dependent on the content of allicin and its transformation products, which are in turn highly dependable on the method of preparation.

Cultivation

Propagation

True garlic seed is not available; therefore garlic bulbs are purchased and separated into cloves just before planting. This procedure is known as cracking, and is labor-intensive if done by hand. Buyers should purchase the healthiest stock available. Only healthy cloves should be planted, and it is preferable to plant the largest cloves available. Growers generally retain a part of each crop for replanting the following season. Approximately 700-1000 kg will plant 1 ha. Hardneck garlic produces above-ground bulbils, which can be planted, but as they will not produce multiple-cloved bulbs for more than one year, they are not normally planted.

Cultivars

There are hundreds of cultivars of garlic available worldwide, but only a small number have been tested in Saskatchewan. Yields have not always been consistent within a given cultivar. It is recommended that growers do their own cultivar trials prior to undertaking commercial-scale plantings.

Some of the cultivars that have wintered and yielded well at Saskatoon include Fishlake #1, Fishlake #2, Fishlake #3, Chets #1, Chets #2, White #1, Romanian, Polish #1, Italian #2, De Blanaca, Challis and Flaxcombe. Local growers may be able to provide or recommend other cultivars.

In Ontario, the main cultivar grown is 'Music', a hardneck strain reported to have very high levels of allicin. It has not been widely tested in Saskatchewan. Elephant Garlic is not a true garlic, but rather a large garlic-like leek, and may be less hardy than regular garlic. It has not been grown commercially here.

Time of Planting

Garlic can be planted in spring or fall. Fall planting is somewhat riskier in that there is danger of winterkill, but there is also potential for higher yields with fall planting. In general, fall plantings are made in mid to late September. The cold winter will break the dormancy of the bulbs and allow growth to begin early in the spring.

If garlic is to be planted in spring, previously chilled bulbs should be planted on prepared soil before the end of April. This early planting will allow the plant to obtain sufficient size by late June, when bulbing begins. Late planted crops will bulb poorly and give poor yields.

Field Site and Soil Requirements

A field, which has not recently been planted to onions, should be chosen. Fields with weed problems should be avoided, as garlic is a poor competitor. The planting site should be in full sun, and well-drained. Sandy loams to clay loam soils are usable, but cleaning of bulbs at harvest may be difficult on heavy soils. In addition, heavy soil hinders bulb development, and if it is dry as well, bulbs may be rough or irregularly shaped.

Moderate organic matter content (3 to 4%) is desirable for holding moisture, nutrients, and to reduce soil crusting. Rotted manure or green manure crops can be used to improve soil organic matter content prior to planting. Soil pH of 6.0 to 7.5 is acceptable. If the soil is light, good wind protection is desirable.

Fertility requirements are similar to onions. If soil nitrate-nitrogen content to 60 cm is above 90 kg/ha (80 lb/acre), no additional nitrogen is required. On very infertile soil, up to 130

to 180 kg/ha (116-130 lb/acre) of N can be added. The applications should be split into three to five applications, with the last application provided 4 to 6 weeks before harvest. Phosphate levels should be around 175 kg/ha (156 lb/acre) and potash levels between 225 and 450 kg/ha (201 and 401 lb/acre). The latter is incorporated into the soil the fall prior to planting.

Planting in Field

Cloves are planted 5-10 cm deep, with in-row spacing of about 7-8 cm, although some large-bulbed strains may require up to 12 cm. Rows should be a minimum of 30 cm apart, according to cultivation equipment being used. The cloves are generally hand planted in small plots, but for commercial-scale production, a planter is highly desirable to reduce labor costs. Units imported from the USA and Israel are available from Ontario dealers, with prices ranging from \$1000 to \$10,000.

Irrigation

Garlic requires adequate moisture during growing and bulbing, and is sensitive to moisture stress. Most soils require 2.5 cm of water per week, although if weather is hot and the soil is very sandy, more moisture may be required. It is preferred to cease irrigation by mid afternoon, to allow the foliage to be dry overnight. It is desirable to keep garlic dry in the fall prior to harvest, as this facilitates harvesting, cleaning, and reduces staining of bulb sheaths.

Weed Control

Garlic is a very poor weed competitor and therefore weeds must be diligently controlled. It is preferable that the field be summerfallowed the year prior to planting. Organic growers will find garlic very labor intensive. Only a few herbicides are registered in Canada for garlic. Poast Ultra will control grassy weeds while Pardner and Dacthal will control certain broadleaf weeds. Devrinol DF is registered for both broadleaf and grassy weeds in garlic.

Flower Removal

Hardneck garlic will produce a long flowering stem (scape), which ultimately produces bulbils. The scape should be removed early during its development, as this practice increases bulb yields, particularly in northern climates. There is some suggestion that too early removal of the scapes may cause the bulbs to store poorly.

Insect and Disease Control

Garlic is prone to the same insects as onions. Onion maggots, thrips and wireworms are potential pests, but they have not been serious in commercial plantings here. Research trials at Outlook were devastated by maggots one year, despite the fact that onions at the same site were maggot free.

Viruses are often found in garlic planting stock, but often they are latent and cause little problem. When grown under stress, virus-infected garlic may lack vigor

and produce low yields, particularly if multiple viruses are present. Tissue culturing may be successful in eradicating viruses, but virus-free planting stock is not generally available at present.

Fungal diseases such as white rot, basal rot, botrytis and penicillium mold may be found in garlic planting stock or in the field. Fungicides have not proven effective and so the main method of control is to purchase high quality planting stock and to eradicate diseased plants as they are found. Excessive soil moisture in the fall will promote fungal diseases, as will wounding the garlic during cultivation and harvesting. Garlic needs to be stored under optimum conditions to minimize fungal problems.

Harvesting

Timing of harvest is important. While digging is common in August, it should not occur before the leaf tops die back about 1/3 of the way, in order to allow sufficient time for the bulbs to mature and ensure good yields. If harvested too late, the bulbs may be stained, split open and become prone to fungal infection. Harvesting is usually accomplished by hand or by using an undercutter.

Following digging, the bulbs must be cured. This can be done in the field or indoors, but good ventilation is required. A temperature of 20°C for 20 days is desirable. Following curing, the

tops and roots are removed and the bulbs brushed to remove loose sheaths, dirt and adhering roots.

Storage

The ideal storage temperature is 0°C. At higher temperatures, bulb weight loss, rots and sprouting become a problem. Relative humidity should be in the range of 60 to 70% to minimize disease problems, sprouting and root growth. There should be good air movement within the storage room. Garlic will store 5 to 8 months under these conditions, depending on the variety stored. Planting stock should not be stored at very cold temperatures just prior to planting, but should be held at 6 to 10°C for a few weeks.

Yield

Yield of garlic varies according to growing conditions, cultivars, planting time and plant spacing in the field. In general a good crop should yield about 5 times that what is planted. About 20% of the crop might be kept for future plantings. Yields on the prairies of 2-4 tonnes/ha are common and up to 10 tonnes/ha are possible. Production practices and weather conditions can play a major role in affecting yields. Bulk garlic is usually sold by weight and graded according to size.

Marketing

At the present time most garlic growers find that value-added production is desirable. Pickled and braided garlic, and garlic flavored oils are among the most popular. Organically produced garlic may be in demand at farmers' markets. Imported bulk garlic has kept commercial prices of garlic very low. Garlic has been one of the top five selling herbal products in North America over the last four years. Medicinal markets, however, are dominated by four large companies in North America and hence the opportunity to market garlic for medicinal purposes appears limited. Potential growers should carefully investigate markets before commencing large scale production of garlic.

Cost of Production

Detailed cost of production figures for Saskatchewan are unavailable. Elsewhere, costs of production have ranged from \$0.75 to \$1.25 per pound, with wholesale market prices ranging near \$1.00 per pound for bulk garlic. High labor costs account for much of the production costs. Initial cost of planting stock is also high, up to \$15-20 per kg in recent years for Ontario organically grown product. Potential growers will need to carefully consider current market options, market prices and the cost of mechanization or hand labor in their planning.

References

Bodnar, J. B. Schumacher and J. Uyenaka. 1997. *Garlic Production*. Ontario Ministry of Agriculture, Food and Rural Affairs.

Engeland, Ron L. 1991. *Growing Great Garlic*. Filaree Productions, Okanogan, WA

Saskatchewan Herb & Spice Association 2000: *Herb and Spice Production Manual*

Medicinal Garlic, An Industry Overview. 1992. Marketing Development Branch, Saskatchewan Agriculture & Food.

Written and edited by:
Brian Porter, Saskatchewan Agriculture & Food; Doug Waterer, Dept. Plant Sciences, University of Saskatchewan; Branka Barl, Herb Research Program, University of Saskatchewan.